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COTTON

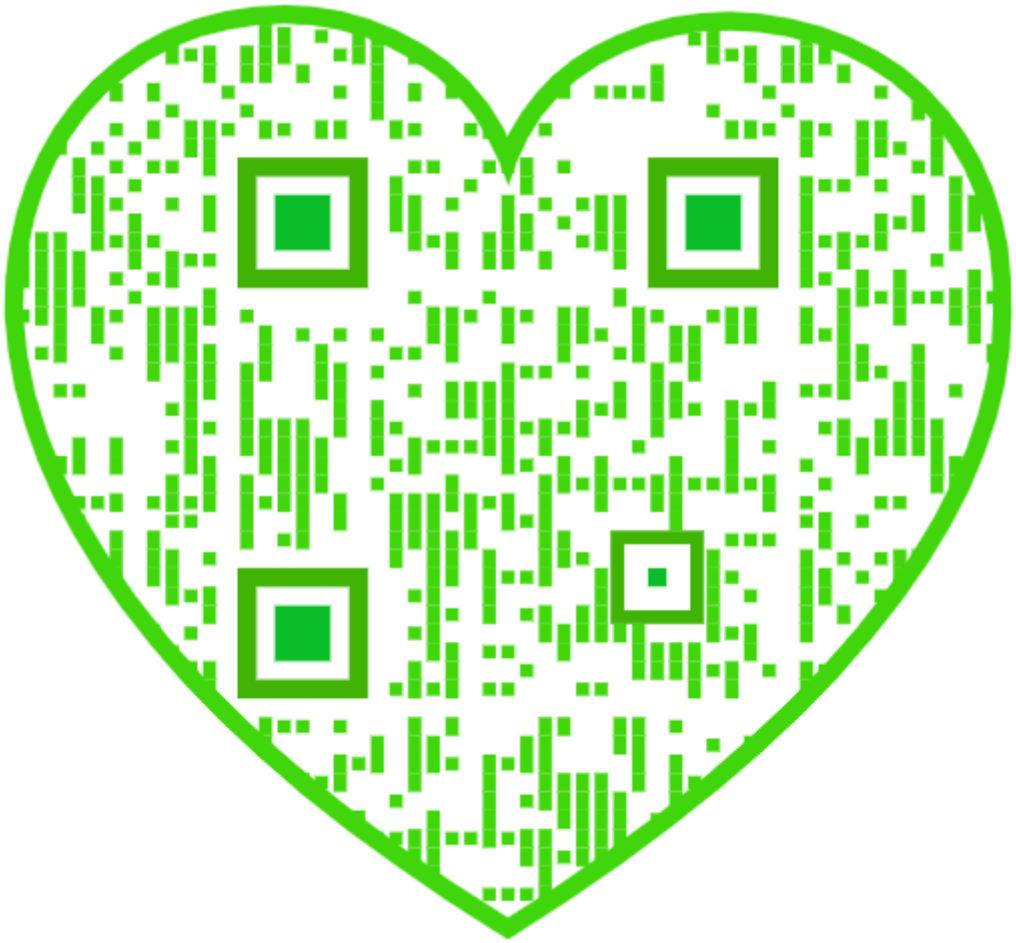
AND

COTTON MANUFACTURE

A BRIEF ANALYSIS
FOR THE LAYMAN

1st Edition

THE FIRST NATIONAL BANK
OF BOSTON



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A BRIEF ANALYSIS
FOR THE LAYMAN

BY

JAMES PAUL WARBURG

OF

The First National Bank of Boston

[1st ed.]

[Boston:]

THE FIRST NATIONAL BANK
OF BOSTON

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PREFACE

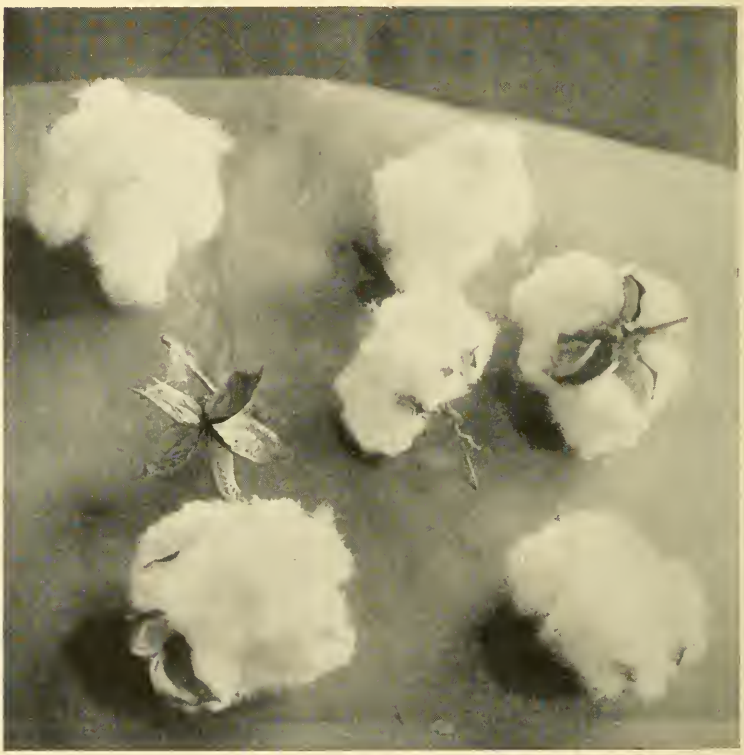
The importance of cotton in the civilized life of today is probably but vaguely realized by the majority of people. In this country we consume raw cotton at the rate of about twenty-six pounds per capita each year, which if translated to yards of cloth and other fabric, would make a strip longer than the distance from the earth to the moon, and a yard wide all the way.

Perhaps the best illustration of the importance of this fibre can be found in the plight of Germany during the recent War. In spite of her accumulated stores of cotton and her domestic production of wool, hemp and flax, in spite of the fact that considerable cotton filtered through in the early months of the blockade, her population at the end of four years was wearing clothes made of paper. Tablecloths, napkins, towels, sheets, underwear, hosiery, not to mention draperies, were practically unobtainable. Bandages and surgical dressing were made of paper; gun-cotton had to be displaced with "Ersatz", as did sail cloth, tire duck, and numberless other commodities.

The following pages attempt to set forth for the layman the essential outlines of the story of the cotton fibre. In Part One we shall take up the raw material,—what it is, and where and how it is grown and marketed. In the second part we shall see briefly how cotton is made into various kinds of finished goods, while the third part will deal with industrial organization and the distribution of finished goods into the channels of consumption. Lastly, in Part Four we shall sketch the relative position of the United States, and the importance of various sections of the country.

In the preparation of this pamphlet many authors have been consulted, but none perhaps as freely as Professor M. T. Copeland of Harvard University, from whose exhaustive studies the writer has gained much of the information contained in subsequent pages. Thanks are due also to many friends of the First National Bank of Boston for their kind assistance in rendering opportunities for first hand observation, and particularly to the Pacific Mills for the loan of their pictures.

Boston, Mass., October, 1920.



Cotton Bolls.

PART ONE
THE RAW MATERIAL

Cotton Field.

CHAPTER I

The Cotton Plant

Derivation of Names

The word, "Cotton", is said to be derived from an Arabic word, "Qutun", originally meaning flax; and the botanical name of the plant, Gossypium, signifying the fleece worn, was first found in the writings of Pliny, and is derived from the Sanskrit. Thus, in the mere origins of the colloquial and scientific designations of the plant, we have ample proof of its antiquity.

Botanical Types

The cotton plant belongs to the mallow family and is a native of the tropics. The genus has a great many botanical varieties, all of which, in the wild state, are perennial, but under cultivation tend to become annual. One variety, Gossypium Arboreum, which is found chiefly in Mexico and Brazil, attains a height of over fifteen feet. This tree cotton, however, has not been extensively cultivated because of the obvious expense of picking. Of the herbaceous varieties the most commonly known are the American and the long-staple Egyptian. G. Barbadense, known as Sea Island cotton, is another long staple variety which is grown only in certain counties of Georgia and Florida.

The Cotton Plant

In all the cultivated species the plant attains a height of about two feet. The leaves vary, but all have characteristic lobes. The blossoms also vary a good deal in color, but have this in common that the seeds are contained in a pod or boll which is filled with a floss not unlike that of the common milk-weed. In due course the boll bursts, exposing the mass of fluffy fibre from which the plant derives its extraordinary value. The superiority of cotton over other vegetable fibres, such as hemp or flax, is in the natural twist, which makes it inherently adaptable to spinning. The single fibre consists of a hollow tube having transverse joints at irregular intervals, and this tube, when dry, has a tendency to flatten out and curl. The more of this natural elasticity is found in the fibre the better it is for spinning purposes, and an immature fibre is for this reason unsatisfactory. Cotton is exceedingly susceptible to moisture, and a succession of violent atmospheric changes will cause such a rapid contraction and expansion in its fibre as to destroy its elasticity. From the point of view of the manufacturer there is very little difference between immature cotton and that which has suffered loss of vitality.

The Fibre

Seeds and Stems

Besides yielding a natural wool from which a tremendous number of products are derived, the seed of the plant gives forth a highly useful vegetable oil, and the stems and leaves are used for fodder.

CHAPTER II

History and Distribution

Ancient History

The origin of the cultivation and commercial use of cotton is shrouded in the dim veils of antiquity. The records of India show that the plant was grown, and its fibre utilized, from the earliest times. The Phoenicians and the Hebrews are known to have made cotton clothing, and later the art was transmitted by them to the Greeks and Romans. The vague annals of China indicate a familiarity with this plant and its value extending back to the remote past, and the same is true of Japan. Cortez found a flourishing textile industry among the Aztecs in 1519, and in Peru, Pizarro found cotton garments said to antedate the civilization of the Incas. Again early Portuguese chroniclers relate the discovery of native cotton in Brazil.

Europe

The Arabs and Saracens were largely responsible for the introduction of the textile industries to western Europe in the ninth century, but it was not until about the middle of the seventeenth century that any great progress was made. During this time the British began to attempt the cultivation of cotton in their colonies, and it was about 1650 when the first Virginia plantations were begun. Since that time the United States has forged ahead until at present it grows over three-fifths of the world's crop.

America

Egypt

The cultivation of cotton in Egypt was begun about 1821, American Sea Island seeds being imported at that time. The fertile alluvial soil of the Nile delta was found particularly adapted to this use, and extensive irrigation later expanded the area. The construction of the Great Assouan Dam late in the nineteenth century gave a tremendous impetus to the industry. Egyptian cotton is mostly of the long staple variety, the best, known as Sakellarides, averaging an inch and three quarters. The 1919 crop consisted sixty per cent. of this variety, the remainder being composed of Ashmouni, Mitafifi, Abassi, and other kinds, roughly classed as Upper Egyptians.

India

Cotton culture in India is perhaps the oldest of all, but Indian cotton is of the short staple variety, and can only be used by certain manufacturers most of which are located in Japan and Germany. About twenty-five million acres are said to be under cultivation, but statistics are very meagre.

China

China has long been a large grower of cotton, but the native species are of a harsh, short fibre. Korea and the Yangtze and Wei basins are the chief sources, and American cotton has recently been introduced in the southern provinces.

Other Countries

Russia began to raise American cotton on a large scale in Turkestan only some fifteen years ago, and bids fair to become a large producer.

The plant is indigenous to almost all the Central and South American countries, and particularly in Mexico, Brazil and Peru, it has great potentialities. Peru has two kinds of native cotton known as the rough and smooth varieties. The former is of a very long and tough fibre and is valuable because it can be blended with wool.

American Varieties

The greatest part of the American crop consists of the Upland variety, although, as we have noted, there is a small but important crop of Sea Island in the Southern Atlantic states. Another long staple species, known as Pimas, has recently been introduced in Arizona, and the alluvial soil of Mississippi, Arkansas, and Louisiana has produced still other desirable species, locally known as "Rivers," "Peelers," and "Benders." Before we consider the relative manufacturing merits of the various kinds of cotton, it would perhaps be well to consider briefly how the crop is grown.

CHAPTER III

Cultivation

The cotton season of course varies in different latitudes, but the planting is done everywhere in the early spring months. The proper care and fertilization of the soil and its preparation to receive the seed is of the utmost importance. The plant ripens in about four months, so that the picking season in this country usually begins in August, and continues until the first killing frost. From the time of the opening of the first bolls the cotton continues to grow, unless killed by drought or insects, until the cold puts a stop to vegetation, and the same stalk frequently contains ripe and immature cotton at the same time. The cotton which matures first and has been least exposed to weather when picked is likely to be freer of spots and discolorations than that which is picked at the end of the season.

Growth of the plant

Enemies of the plant

The two great enemies of the cotton plant are drought and insect depredations. Late frosts and the right quantity of rain and sunshine are what every cotton planter prays for, and praying is about all he can do in this respect. Not so, however, with insects. Unfortunately there are a great number of rapacious little creatures rendered particularly hardy by some caprice of Nature, to whom the growing cotton plant represents an especial delicacy. Against them the planters, under the guidance of the Department of Agriculture, are waging continuous warfare. It is said that insect depredation, at pre-war prices cost the country an annual sum of $60,000,000, more than half of which is attributable to the two worst offenders, the boll weevil and the boll worm. Coming in hordes across the Mexican border, the boll weevil has destroyed millions of bales of cotton annually, and as yet no very effective remedy has been found to exterminate it.

The Boll Weevil

Even at that, however, the planter's greatest worry is perhaps not so much the growth as the harvesting of his crop. To get his cotton picked rapidly and properly, an operation for which no successful machinery has yet been devised, and to have it properly ginned, presents his chief problem. If cotton is left too long on the stem it will be exposed to the detrimental effects of the weather. Coloring matter from the newly opened bolls, or from the soil, is washed into the floss by the rain, and while such spots or stains may be bleached out by the sun, the lustrous bloom never returns. Frost will make permanent tinges or stains, and the wind will frequently wrap the pendulous locks of fibre-covered seed about the stems of the plant or tangle them up in the leaves.

Weather Defects

When the pickers do not exercise proper care stems and leaves frequently get picked along with cotton, and a considerable quantity of dirt inevitably finds its way into their bags. Or else the cotton may be picked when it is damp, with the result that the teeth of the gin, instead of picking out the seeds and stems will cut the matted fibres, producing a class of cotton known as "Gin-cut". Moreover the gin brushes will be unable to separate the matted tufts, and so they go into the bale as "naps" or "neps". All these factors militate against the planter in his efforts to have his crop classified as high as possible.

Careless Picking

Bad Ginning

CHAPTER IV

Grades and Staples

Grades Based on Condition

The classification of cotton into the standard grades fixed by the Government constitutes an exceedingly difficult art. There is absolutely no mechanical basis, and the classification is a purely relative one. The kind of plant has no bearing whatsoever, nor has the length or strength of staple. It is really a distinction based upon the condition of the cotton, rather than upon its inherent attributes.

The grade "MIDDLING" is the basis upon which the market values of the other grades are quoted. There are eight full grades:

The Full Grades

Fair	*Low Middling*
Middling Fair	*Good Ordinary*
Good Middling	*Ordinary*
Middling	*Low Ordinary*

Tinges and Stains

Between these full grades are the half grades, known as the Stricts, and some classers use quarter grades with which, however, we shall not concern ourselves here. The grades and half-grades are quoted for whites, tinges, and stains. A stain is a heavy discoloration while a tinge is a lighter hue, and partial discolorations, known as spots, are per-

missible in the lower grades of whites. The values of the various grades are always quoted as so many points on or off White Middling, a point being 1/100th. of a cent. Thus, if Middling White were quoted at 24c and Ordinary as 300 points off, it would mean that Ordinary was worth 21c. An example is given below of a regular quotation sheet. *"Points"*

U. S. Grades	*White	**Tinges	**Stains
Middling Fair	403 on	Nominal	Nominal
Strict Good Middling	328 on	49 off a	Nominal
Good Middling	253 on	152 off a	447 off a
Strict Middling	135 on	300 off a	618 off a
Middling	Basis	456 off a	809 off a
St. Low Middling	305 off	704 off a	Nominal
Low Middling	843 off	1064 off a	Nominal
Strict Good Ordinary	1230 off	Nominal	Nominal
Good Ordinary	1518 off	Nominal	Nominal

*U. S. Government differences.

**Average of differences on New York, New Orleans, Memphis and either the Savannah or the Augusta exchanges.

It is obvious that in this classification the human element plays a great part. The difference between quarter grades, or even half grades, or between a tinge and a stain, are subject to a great variety of interpretations. While there is no definite standard, Middling must be cream or white, must show no soil evidence, no gin-cuts or naps, may have a few pieces of leaf (not powdered), and a few motes, (immature seeds). As the grades go up the cotton must be freer of impurities until the top grades have to show practically a perfect lustrous, silky, white, and clear fibre. On the lower side the impurities increase, until, in the Ordinaries, we find large and small leaf particles, sticks, hulls, dirt, sand naps, gin-cuts, and spots, together with a dingy color. *The Human Element* *Proportion of Impurities*

It is this classification that governs the trading on all the exchanges, and upon which the planter originally sells his crop. The exceptions are those varieties of cotton which are distinct from the crop as a whole. Sea Islands are sold as Fancy, Choice, Fine, Medium, and Common. Bolly or immature cotton is sold by separate agreements; and Linters, the fibres regained by the seed mills from reginning the seed, are not sold on this basis. Neither is what is known as the "City Crop" of loose cotton accumulated from taking samples, sold in this way. (Incidentally, as the result of the sampling of 14,000,000 bales, it is estimated that the yearly "City Crop" amounts to three hundred thousand bales. *Some Cottons not Sold on Middling Basis*

Aside from grade there are two other qualifications which are of equal importance to the manufacturer: length, and strength. Lengths are quoted in eights of an inch, and cotton under 1⅛" is termed short, *Staple Length*

while that over 1⅛″ is long. The normal lengths run from ¾″ to 1⅞″, and it is noteworthy that, where a normal difference between grades would be 25 points, the difference of ⅛″ would be about 250 points. "Pulling" for staple is another art where the individual's judgment plays an important part.

Elasticity

Strength,—elasticity and tensile strength,—is again one of the mill's prerequisites. The usual buyer's test for fibre vitality is to compress a sample in the hand to see if it will return to its former shape. The importance of length is that it governs the fineness of the yarn to be spun, while grades affect the finish of the cloth. We shall see later that mills cannot buy mixed lots, but must have even-running grades of fixed staple.

CHAPTER V

Buyers of Raw Cotton

Store-keepers as Local Buyers

The small planters of the South are usually unable to finance themselves independently through the growing and picking seasons. Consequently the local store-keeper, from whom the planters buy their supplies, usually extends credit in the form of an open account and so becomes the first middleman. Not infrequently the store-keeper will accept cotton rather than money in settlement of his accounts and where he follows this practice he becomes what is known as a local buyer. When he has accumulated sufficient cotton he sells either to an intermediate buyer, or to the buyer for some merchant or mill.

Large Growers

In the case of the larger grower, or the syndicate of growers, the local buyer is usually eliminated. The planters obtain their credit from the large merchant buyers, who in turn are carried by their banks.

Intermediate Buyers

Very frequently the local buyers are scattered so thickly through a neighborhood, and each accumulate such small and heterogeneous lots of cotton that an intermediate buyer finds his way into the natural order. Sometimes the intermediate is merely a "scalper" who buys from the local dealer and sells to merchant buyers. In other cases, notably in Texas, he acts as a concentrating agent, buying at local points from growers and selling, usually at compress points, to representatives of merchants or mills. In the latter case he is referred to as a "street buyer."

Financing Early Stages

Where the grower surrenders his cotton to the local dealer the latter usually has it ginned, but in cases where the planter is able to finance himself he takes his cotton to the gin himself, pays for the ginning, and either sells in so-called gin bales, (before they are compressed) or, if a warehouse is available at the gin or compress point, holds his cotton until he can obtain a satisfactory price for it. The local banks

perform a very important part of the crop financing at this stage, for, since the grower sells for cash, the buyers require advances. These are made by the Southern banks against buyers' tickets, showing cotton purchased, against gin receipts, warehouse receipts, compress receipts, and finally when the cotton is shipped, against bills of lading.

The Merchant Buyer's Importance

The large cotton merchants fulfill a very essential function in that they are responsible for the concentration of the raw material and for its redistribution into the proper channels of manufacture. They maintain branches and representatives throughout the entire cotton growing areas and are directly connected by wire with all the important exchanges. By far the bulk of their buying is done after the close of the New York Exchange from local and intermediate buyers who during the day have been acquiring mixed lots of all sorts. The merchant's representative, known as the take-up man, goes over and classifies the cotton accumulated by the local buyers, takes a sample from each bale which he tags with a duplicate of the shipping tag he places on the bale itself, and then ships the cotton to the concentration point and the samples to the office at that place. He pays the local buyer by draft or check.

The Take-up Man

Even-running Lots from Compress Point

The office at the concentration point, usually where there is a compress, has in the meantime received instructions from the head office as to how to make up the various lots. As the bales are compressed they are collected into even-running lots of certain grades for which the head office has received inquiries from mills, and are shipped out in this way. The branch office will ship according to instructions forwarding the bills of lading with invoices and sight drafts to the head office or to some bank.

Almost all cotton is bought on Middling Basis, but some is taken on sample with guarantees, (often a dangerous practice for both parties), and some is taken at a fixed price per bale.

Direct Buying

A few Southern mills buy direct from nearby growers, but the preponderant majority and practically all the Northern mills obtain their cotton through merchants, or through brokers representing Southern merchants.

We have seen briefly how the cotton is grown and brought to market. but we have still to consider the all important question of what determines the price at which it changes hands.

CHAPTER VI

The Cotton Exchanges

"Spot" and "Futures"

Cotton trading falls roughly into two categories: trading in cotton for immediate delivery, or spot cotton; and buying or selling for delivery at some future time. Purchases or sales of spot cotton mean that cotton actually will be delivered from vendor to purchaser, but, as we shall see, trading in futures does not necessarily mean that the contract will be fulfilled by delivery. The great cotton markets are New York, Liverpool, New Orleans, Bremen, and Havre. Of these New York is almost entirely a futures market, while New Orleans is chiefly a spot market. Liverpool, Bremen, and Havre trade in both spot and futures, but Liverpool is the European centre for trading in future contracts.

The Great Markets

The New York Cotton Exchange

Only about 2% of the annual crop is sold spot in New York, and yet it is the prices on the New York Cotton Exchange which govern very largely the price paid to the grower in the South by the various buyers. The New York Exchange is the barometer of the American, and to a large extent, of the world's cotton trade, because its mechanism works out the equilibrium between demand and supply; and as this mechanism consists chiefly of the trading device called the "Hedge", we shall digress for a moment to consider its operation.

The "Hedge"

We might say that hedging is an insurance against fluctuations in cotton prices by purchase or sale of future contracts for cotton against sale or purchase made for actual delivery. It consists of nothing more than of neutralizing the gain or loss which will result from existing delivery contracts if the price rises or falls before delivery date, by creating an off-setting loss or gain.

As Used by the Merchant

Assume, for instance, that a merchant makes a contract with a mill in July for 100 bales October delivery. He sells at the current price of let us say 30 cents per pound plus his overhead and profit. In due course he will obtain his cotton from the South, but in the meantime he covers, or hedges his contract by buying 100 bales of October futures on the Exchange. If he has to pay the grower 31 cents for the cotton which he has sold to the mill for 30 cents, he will on the other hand, be able to sell his future contract which he bought at 30 cents for 31 cents, so that the loss on one is neutralized by the gain on the other. Vice versa, he will lose whatever *extra* profit he might have made from a falling price.

By the Manufacturer

In the same way a manufacturer may buy futures against orders he has accepted for goods, based on the price he expects to pay for his cotton. Or he may sell futures to protect himself on cotton he has bought but has not yet covered by cloth contracts. Hedging by manufacturers,

however, particularly in the North, is not a common practice, because the cloth market is not elastic enough to follow accurately in the wake of cotton prices, and also because the mill treasurer rarely wants to hedge cotton in his warehouse, preferring to rely on his own judgment in matters of purchase.

By the Grower

Occasionally a grower may find it to his advantage to hedge his crop. If, for example, he is satisfied in August that the present price for December is likely to be higher than he will obtain later, he may sell December futures for a conservative percentage of his crop, thereby guaranteeing himself against a drop.

Speculation

By far the greatest part of the future trading, however, is done by merchants, because they are actually engaged in the business of selling cotton which they have not yet acquired or of carrying cotton for which they have no contracts. Speculation, of course, enters into the dealings on the exchanges as an important economic factor, in normal times tending to stabilize by discounting future trends, but in periods of extraordinary demand or supply frequently causing violent fluctuations in prices. At such times there is always a good deal of agitation for preventive legislation, but it is unlikely that dealing in futures will ever be prohibited by law. The present regulations of the large exchanges eliminate abuse as far as possible, and the futures markets are really a factor of safety for the entire industry.

The dissemination of Quotations

All the large merchants, as we have seen, have branch offices in the South, and all these offices have wire connections with the chief markets. On the basis of the Liverpool quotations and the New York opening prices the head offices will send out to their branches and representatives their daily limits, above which they are instructed not to buy. Inasmuch as most of the small growers are dependent for their news of the markets upon the buyers, they are at somewhat of a disadvantage, but the keenness of competition prevents their exploitation by unscrupulous buyers.

New York Cotton Contract

A contract on the New York Cotton Exchange calling for the delivery of 100 bales specifies Middling grade, but the seller may deliver any grades which are tenderable by the Exchange regulations. These grades are from Strict Low Middling to Middling Fair, but if tinged, not below Middling Tinged. Stains are not tenderable. The grades are determined and settlement made on the basis of so many points on or off Middling, which, as we have seen, is the basis for all quotations.

It is evident that mills, which require certain even-running grades, could of course never buy their cotton on the Middling basis. For this reason, except in the few cases where they buy direct from the growers, mills purchase their requirements from dealers on the basis of samples. Selling to mills, as opposed to selling M/B, is known as selling on merit. Mills usually begin to buy in September and fill about 60% of

Buying Season

their year's requirements by January. Those manufacturers who use the high grades usually buy earliest because of the limited crop from which they must obtain their share. Cotton is ordinarily shipped soon after purchase and stored not by the merchant but at the mill. The recent growth of Southern warehouse companies, however, has caused mills to carry less cotton than formerly. Mills ordinarily pay for their cotton in three days.

We have now traced rapidly how the cotton is grown and marketed, and our next concern will be to follow what happens to it during the process of making it into goods. Deferring for the moment consideration of cotton export from the United States, we shall proceed in Part Two, to glance at the various aspects of Cotton Manufacture.

PART TWO

THE MANUFACTURE OF COTTON

The Square Bale.

CHAPTER VII

History in the U. S.

Much has been written on the subject of the textile industry and perhaps even more still remains to be said. It is not the object of this brief survey to present a complete picture of all the stages of manufacture, but rather to place briefly before the reader a necessarily kaleidoscopic view of the various processes. In a pamphlet, "Wool and Wool Manufacture," published in June, 1920, by the First National Bank of Boston,* spinning and weaving were discussed at somewhat greater length than will be possible in these pages, where we shall concern ourselves more with those features of cotton manufacture which are unlike its sister industry.

Slater's Mill

Although the first cotton mill in the United States was founded in Rhode Island by Samuel Slater in 1790, Whitney's invention of the cotton gin in 1793 marked the real beginning of the cotton growing and manufacturing industries in this country, because it solved the hitherto vexatious problem of separating the fibre from the seed. Nevertheless, until the war of 1812, this country exported almost all of its cotton to Great Britain, and imported from there its cotton goods. The war stimulated the textile industry for two reasons: first, because no British goods were available; and second, because it brought about the transference of New England capital from ships and commerce to home manufacturing industries. The census figures for 1805 show 4,500 spindles in the country; in 1825 there were 800,000.

Whitney's Gin

Stimulus of War of 1812

Various inventions, notably Lowell's power loom in 1814, and Jenck's ring spindle in 1830, made it possible for the New England manufacturer to compete with the skilled labor of England, and up to the time of the Civil War the industry made rapid strides. In 1831 795 establishments with 1,200,000 spindles used 77,800,000 pounds of cotton and manufactured $32,000,000 worth of goods. Thirty years later there were 1091 mills with 5,200,000 spindles using 422,700,000 pounds of cotton and making a product worth $115,700,000. At this time 570 of the mills were in New England, 340 in the Middle Atlantic States, 159 in the South, and 22 in the Western States. The New England mills, however, averaged twice as many spindles as the others, and Massachusetts and Rhode Island alone contained 48% of the total.

Growth to 1860

Home industries at this time supplied most of the coarse drills and sheetings, while the fine goods were imported from England. There was a small export trade of coarse goods to Asia. The Civil War cut off the industrial centers from their raw material so that for five years

Civil War

*2nd Edition of this pamphlet is still in print and may be obtained on application to The First National Bank of Boston.

no progress was made, and when normal life was resumed a new tendency towards concentration became manifest. From then on the number of plants decreased and the individual establishment grew larger, so that in 1880 there were fewer mills and four and one-half times as many spindles as twenty years before.

Rapid Industrial Rise of the South

While we shall discuss the geographical distribution of the industry in a later chapter, it is worthy of note here that the feature of the period beginning about 1880 and extending to the present time, was the gradual growth of the spinning and weaving industry in the South. The social and economic system in the Southern states before the abolition of slavery made those states entirely agrarian, but as soon as a recovery from the war was accomplished, manufacturing, and particularly cotton manufacturing, grew up surprisingly fast. A glance at the growth in spindlage in the United States from 1880 to 1910 will suffice to illustrate. The units represent millions.

	1880	1890	1900	1910	Inc. 30 yrs.
North	10.1	12.6	14.5	17.4	7.3
South	.5	1.7	4.5	11.2	10.7

Sixty per cent. of the increase since 1880 was in the South. We shall discuss the present relative positions of the various sections in Part Five, and shall proceed now to a brief analysis of what the manufacturing processes are.

CHAPTER VIII

Making Cotton Yarn

Almost all cotton comes to the mill in standard compress bales of five hundred pounds gross. The cotton is condensed to about 35 pounds per cubic foot at the compress, wrapped in coarse jute bagging, and circled with iron hoops. (See figure 3.) For some time there has been a movement to improve the so-called square bale, or to replace it with a different form of packing. Sea Island cotton is frequently packed in a smaller round bale, and there is much to be said for this practice. What we are concerned with here, however, is that the mill receives the cotton in a compressed form which must be loosened before anything can be done with it.

The Bale

Accordingly, the first thing that happens is that the hoops are cut, the bagging removed, and the cotton thrown by hand into the feed-apron of the bale-breaker. This machine does nothing more than to pick the compressed cotton apart and deliver it in tufts about the size of a handfull on a belt conveyor.

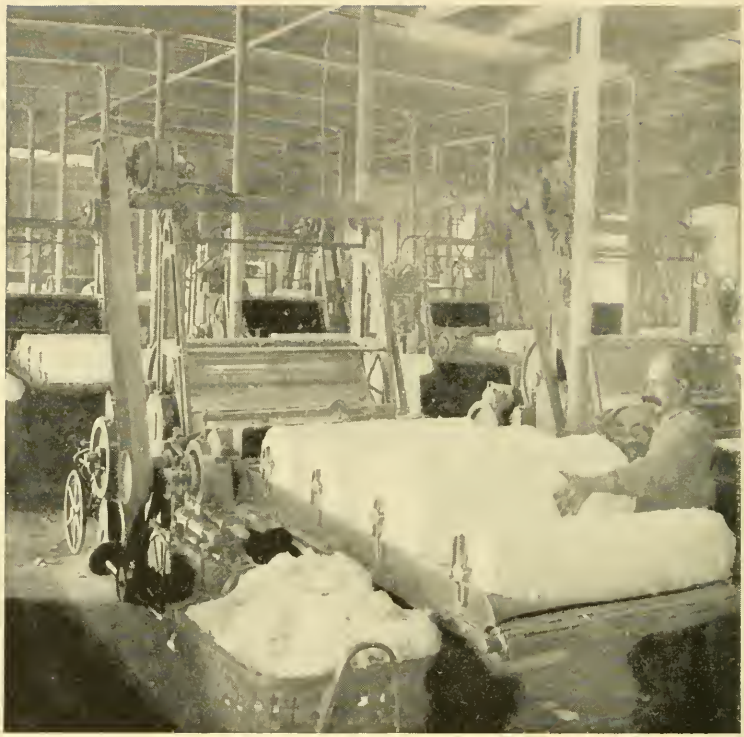
The Bale-Breaker

Bale Breakers.

The Opener

The travelling belt or feeder delivers these bunches of cotton into machines called Openers, which simply repeat the operation of the bale-breaker on a more thorough scale, reducing the large tufts into many smaller ones. These small pieces are dropped into an air chute and drawn along parallel rods up to the picker room. During transit in the trunk much of the heavier dirt falls between the rods and is removed.

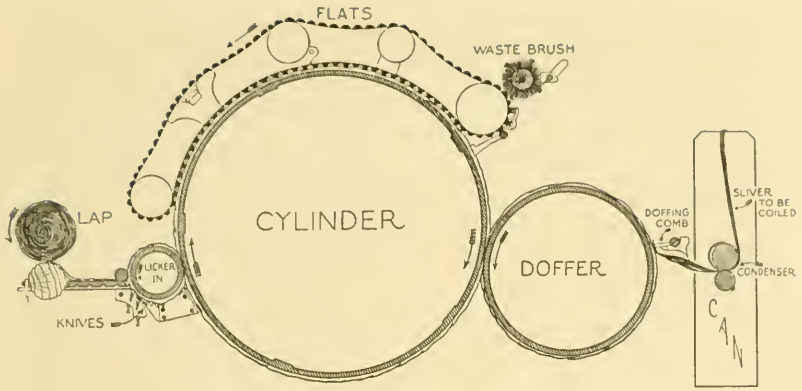
In the most recent installations larger bale-breakers are used which reduce the cotton to small tufts and deliver through an air pipe to a condenser in the picker-room. The condenser either empties into bins or else on to the automatic feed of the breaker-pickers.



Picker Room.

Pickers Remove Coarse Dirt

As the tufts come out of the chute they fall into the first of three machines known as Pickers, whose function is to beat out the coarser impurities and deliver the cotton in rolls of batting called laps. In the first, or breaker-picker the tufts are thoroughly whirled and pounded over grid-bars by rollers armed with short flail-like projections, and then compressed into a continuous sheet or lap of a given weight per yard, which is wound on a large spool and delivered to the second, or intermediate picker. This machine practically repeats the operation only that it combines four laps from the first picker into one which it hands over to the last, or finisher picker. The latter again takes four intermediate laps and forms them into one sheet of fairly clean cotton, containing very little dirt or seed, but still fairly filled with small particles of leaf. In these preliminary operations the cotton has lost about five per cent. of its weight.



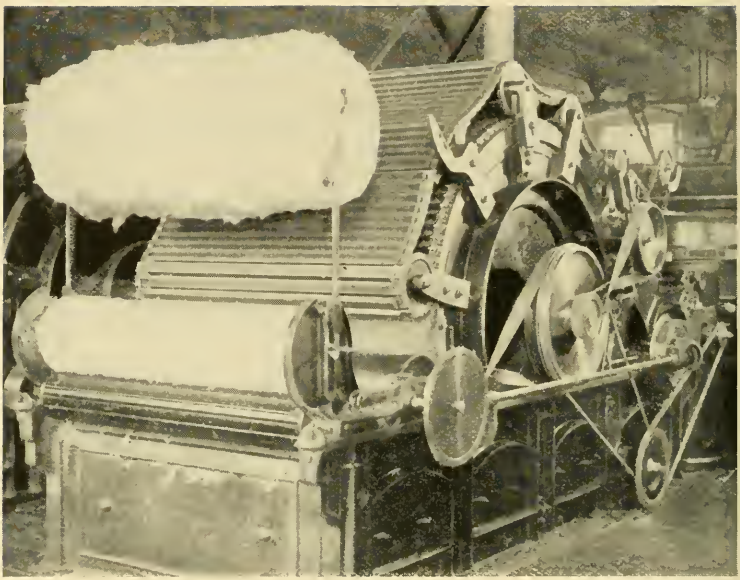
PRINCIPLE OF THE FLAT CARD

The Function of the Card

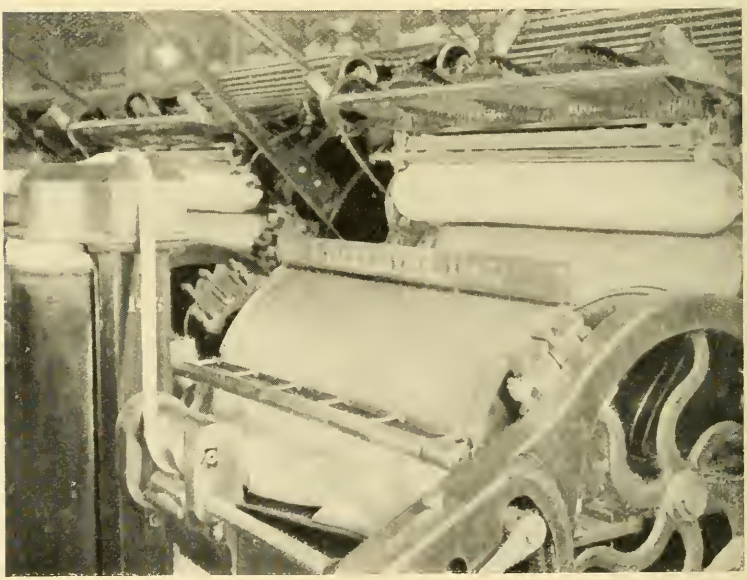
Before anything else can be done it is now necessary to remove the leaf particles, and to separate the individual fibres from their matted position. Both these functions are performed by the machine known as the Card, the principle of which is that of two surfaces armed with fine wire teeth revolving not quite tangent to each other. Originally carding was performed by hand with two instruments similar to butter-pats, but the Wellman carding machine was one of the earliest textile inventions. This was considerably improved by the revolving flat card in 1857.

Its Operation

The lap from the finisher picker is fed over a plate on to a revolving cylinder bearing wire teeth, which combs it over a set of knives, thereby removing coarse dirt, and passes it on to a large cylinder armed with millions of fine wire teeth. The latter carries the cotton past a slowly revolving endless chain of flats which remove the neps and fine dirt. The clean, separated fibres are then picked off the cylinder by a smaller rapidly revolving roller called the doffer, which carries them in a filmy sheet to be in turn removed by the doffing comb. The latter, working so rapidly that the eye fails to see it, lifts the sheet of fibres clear so that it may be passed through a funnel and condensed into a single untwisted rope a little under an inch in diameter. This rope is called a sliver, and is automatically coiled into a can like an umbrella-stand.



Feed End of Card. Lap Entering.



Delivery of Sliver.

Drawing.

We have now for the first time reduced the raw material to a continuous strand, comparatively free from impurities. Up to this point, no matter what kind of yarn is to be spun, the operations are practically identical, but from here on the processes vary according to the product desired. A hank of yarn is 840 yards (not to be confused with the worsted hank of 560 yards) and the number of hanks it takes to make a pound is the basis upon which yarn is classified. Thus a coarse yarn which weighs only twenty hanks to the pound, would be called 20s, while 80s would be a very fine yarn. Various fabrics require different grades of yarn, just as different finenesses of yarn must be spun from varying grades of cotton. The processes preparatory to spinning vary, not only with the counts to be spun, but with the use to which the yarn is to be put. Ordinary coarse and medium yarns for weaving usually follow one process, while fine counts for weaving, or knitting yarn, or coarse yarn made from long-staple cotton such as that used for tire-duck, go through a different preparation. The former are simply drawn and reduced, while the latter are in addition combed.

Counts of Yarn

Two Processes

Roving Frame.

First Process

In the ordinary process, which is by far the most commonly used, the sliver from the card is put through successive similar operations, known as drawing, the object of which is to draw out the fibres and cause them to lie parallel to each other. Six card slivers are fed together between two pairs of rollers, the second of which is revolving faster than the first. The obvious result of this is the stretching of that portion of the slivers which is between the two sets of rollers. The operation is usually performed two or three times, in each case combining six strands into one. The sliver delivered by the third drawing machine will be of the same diameter as the original card sliver, but will contain more or less parallel fibres.

Drawing

Four Stages of Roving.

Roving Operations

There remains now only one series of operations before the yarn is ready to be spun. The sliver must be reduced in size and given a certain amount of twist; these objects are accomplished by the roving frames, of which there are either three or four. The first, or slubber, passes the drawn sliver through rollers without combining, and winds it up on bobbins set in spindles. The sliver is twisted by being fed onto the bobbin by an arm, or flyer, which revolves a little more slowly than the spindle, being drawn around after it. The result is a slightly twisted sliver, now called a roving, about the diameter of a clothes-line.

Slubber

The intermediate, fine frame, and jack frame,—or, if there are only three roving boxes, the intermediate and fine frames,—combine two rovings into one of smaller size and more twist. The mechanism is much the same, except that in each successive frame the spindles are smaller and revolve faster, until finally the thread is small enough to spin.

Second Process

Where it is desired to spin special kinds or very fine yarns twenty card slivers are usually combined in a machine similar to a drawing frame and known as a sliver-lapper. The twenty ends are drawn between rollers and delivered not as we should expect in one strand, but in a narrow band or lap, which is wound on spools. Four of these

Lapper

laps are again combined and drawn over a spiral surface in the ribbon lapper which delivers its product to the comb. The cotton is now in a band less than a foot wide, with fibres more or less parallel and practically clean. Since it is desired to spin a yarn which demands not only parallel but uniform fibres, the short fibres must be eliminated.

The Comb

There are a considerable number of combing machines in use at the present time, but their differences are mechanical rather than in the function they perform. The Heilmann principle is the most commonly used in this country. Eight rolls from the ribbon-lapper are placed in separate rests, or heads, end to end, and each lap is fed through rollers between teeth of a very fine and rapidly oscillating steel comb. Every back and forth motion, known as a nip, delivers about half an inch of filmy sheet from which the short fibres have been combed out. The eight combed sheets are then once more condensed into a single sliver and coiled into a cylindrical can.

Drawing

Following the comb there are usually two drawing frames, each combining six slivers into one, and these are followed by the three or four roving frames as in the other process. In the ordinary process the last

Doublings

roving as it leaves the jack frame has been doubled 27,648 times; in the combed yarn there are 2,959,120 doublings before spinning begins.

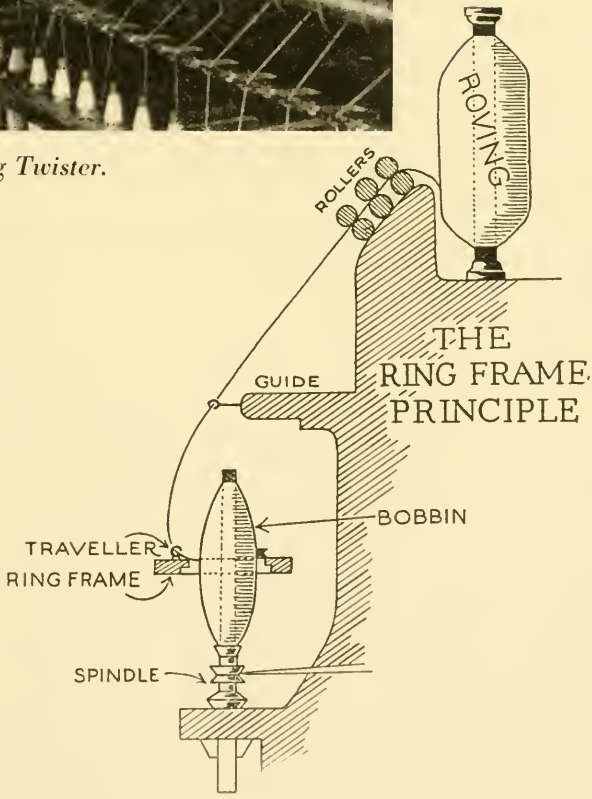
Spinning proper is done either on the mule or the ring spindle. Very little cotton is spun on mules in this country, although mules are extensively used in Europe. (*) We shall concern ourselves here only with the ring spindle, and that in bare outline.

The Ring Frame

The principle of the ring frame is very similar to that of the roving operations which immediately precede it. The thread is again drawn through two or three sets of rollers running at successively higher rates of speed, and then passes as shown on the accompanying sketch through a guide to a small metal loop, called the traveller, which runs around on a metal track or ring within which the spindle with its bobbin is revolving. Since the spindle pulls the traveller around after it, the yarn is twisted or spun as it is wound on the bobbin. Sometimes two spools of roving are spun into a single thread, but more frequently there is no combination. All the rings on one frame, usually about 256, are moved up and down together on their spindles, so that yarn will be wound evenly on the bobbin.

*Mule Spinning is briefly described in "Wool and Wool Manufacture."

Ring Twister.



Yarn of Filling Bobbin, Warp Bobbin, and Spool.

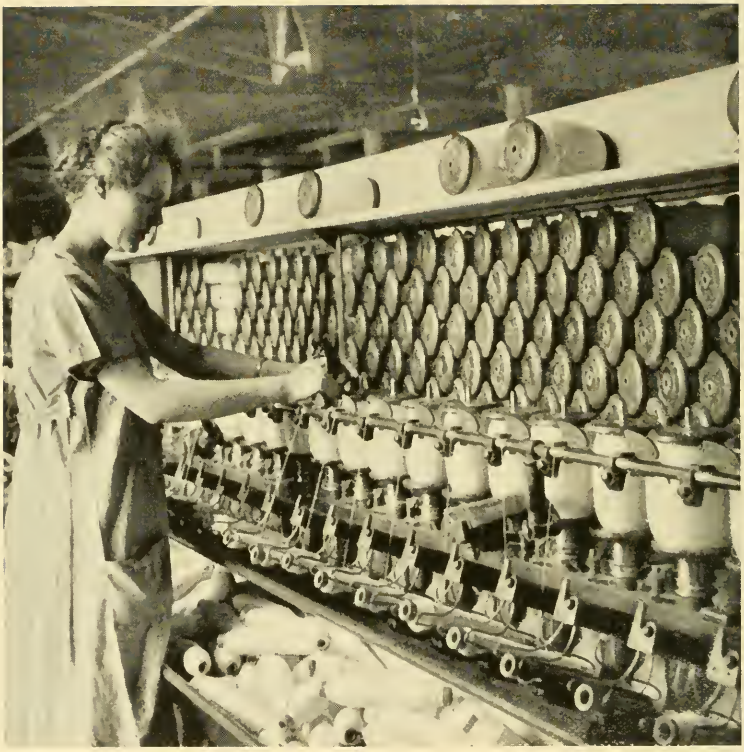
Warp and Filling Bobbins

Not only is a different bobbin used for spinning warp and filling yarns, but they are also wound differently on the bobbin. Warp yarn is wound evenly up and down the whole length of the bobbin, while the filling bobbins, which go straight from the spindle into the shuttle of the loom, are wound on in sections to facilitate rapid unwinding.

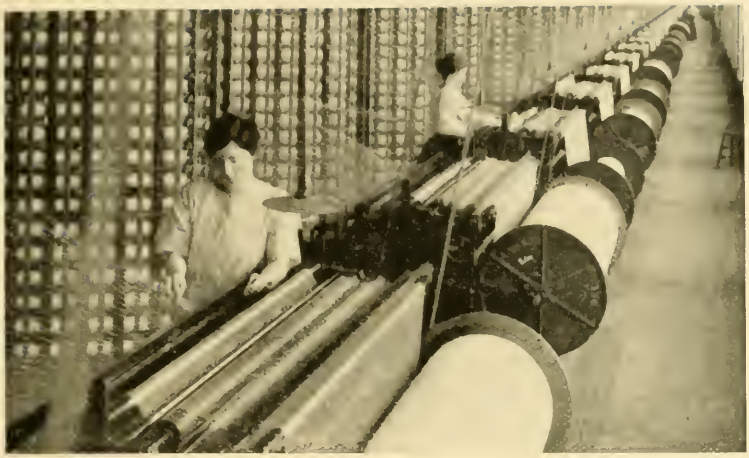
The Barber Knotter.

We have now proceeded as far as the finished yarn. Sometimes, however, when a particularly strong thread is desired, or in cases of fancy designs, it is desirable to twist two or more threads of yarn together, this being known as two-ply, three-ply, etc. Various effects are obtained by twisting different yarns together, and sometimes worsted and cotton strands are twisted together. The operation is done on a frame similar to the spinning frame. *Twisting*

In these and subsequent operations the Barber Knotter, a little device worn on the hand of the operative, has enormously increased efficiency. By a single motion an entirely unskilled girl can knot and cut off evenly the ends of two threads. *The Barber Knotter*



Spooling.



The Creels.

CHAPTER IX

Weaving Gray Goods

Principle of Weaving

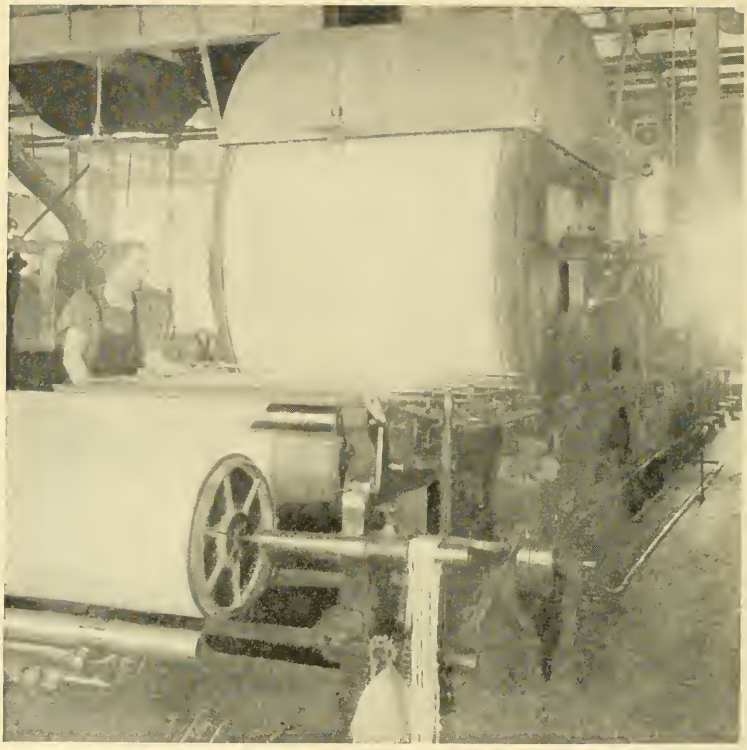
The principle of weaving cloth from yarn is of course a familiar one. The warp threads are stretched out parallel to each other, and the filling, or weft, passed back and forth over and under alternate warp threads. Inasmuch as the weft bobbins are simply placed in the shuttle as they come from the spindle, the preparatory processes of weaving are entirely concerned with arranging the warp. The modern loom is the culmination of years of technical endeavor, and the actual weaving is now done entirely automatically, even to the replacing of empty shuttles with new ones without stopping the loom. The only time when the human operative has to step in is when through the breaking of a single thread the entire mechanism comes to a standstill, or when the beam contains no more warp threads, or the filling magazine is empty. The work of preparing the warp is, however, still an arduous process in which highly skilled labor must be employed.

Spooling

The first operation consists of winding the yarn from the bobbins on to spools, each containing the same length of yarn. This must be done with care or considerable waste will result.

The Creel

The next step is to place these spools in a rack or creel where they fit on glass bearings so that they may be arranged in the proper order and run through the warper on to the section beam. The latter is a

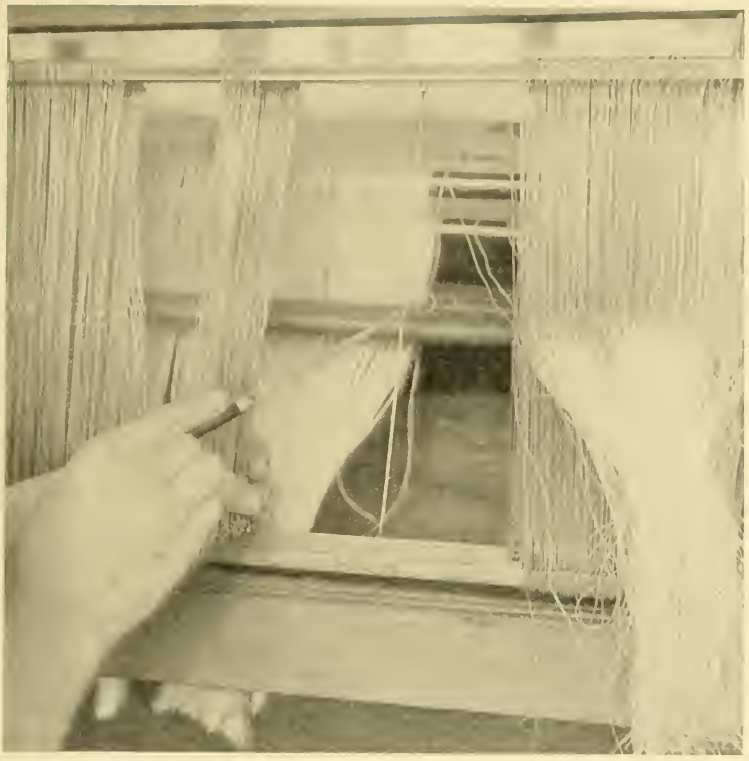


The Slasher.

large roller several of which are combined to form a beam. The beam is the name given to the roller which is placed in the loom to deliver the warp threads.

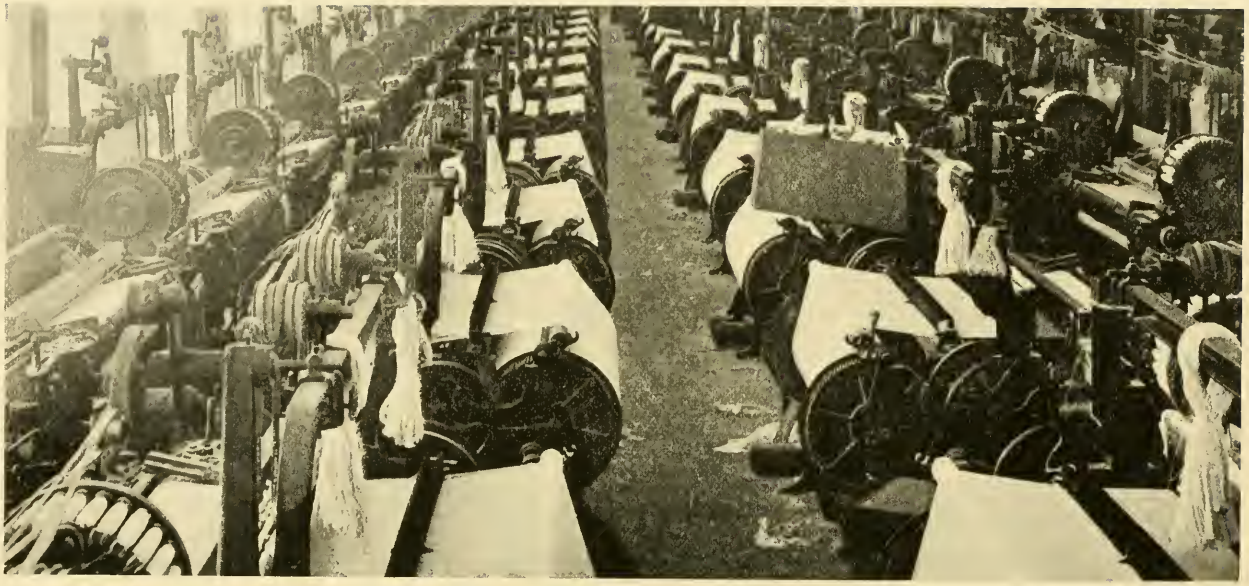
Sizing

In order both to strengthen the warp threads and to make them smoother for weaving it is usual to apply some starchy or glutinous substance to them. This operation, which is performed in a machine called the Slasher, is termed yarn sizing, and consists of running the threads through a bath of preparation and then drying them quickly on a large steam-filled drum or can. One slasher will do enough work for 200 to 500 looms.



Drawing In.

Since it is necessary that the warp threads may be lowered or raised in various combinations to allow the passage of the shuttle, each warp thread must be passed through an eye in the centre of a harness wire. Where, for instance, the warp is to be raised and depressed in three even sections there will be three harness frames, each fitted with enough heald-wires to accomodate one-third of the number of threads in the entire warp. In the Jacquard loom, used for intricate patterns, each warp-thread is separately controlled. The passing of the ends of the warp through their proper harness wires is a delicate and skilfull operation known as healding, or drawing-in. At the same time that this is done the threads are passed through individual stop-motion wires, relaxed tension on any one of which will bring the loom to a stop.



Weaving Shed of Power Looms.

Closely connected with drawing-in, is the final step in the preparation of the warp, and this is called reeding or sleying. In order to keep the warp threads in proper position during weaving they are passed through the wires of what looks like a comb with a strip across the open ends. This, the sley or reed, is attached to the batten on the loom and serves in addition to drive home each weft thread after the shuttle has passed. *Reeding*

When the loom has devoured all the warp threads contained on one beam, all that is necessary, if the pattern is to be continued, is to tie the ends of the old warp to the ends of the new, and this is accomplished with marvelous accuracy by a little machine built on the same principle as the Barber Knotter. This avoids drawing-in a second time. *Warp Tieing*

When the preparatory processes have been completed the actual weaving is done, as we have seen, practically without human agency. The shuttle flies back and forth at the rate of from one to two hundred picks per minute, and when its thread is exhausted it drops out and, in the automatic loom, is immediately supplanted by a fresh one. The harness frames jerk up and down, forming and reforming the V shaped shed through which the shuttle passes; and after each pick the batten drives home the new thread into the ever-growing stretch of cloth. Like the film in a kodak, where a roller at one end gives out plain paper which is rolled up at the other end as a magic sheet of pictures, so in the loom the homely warp threads are rolled out at one end, while the roller at the other extreme winds up smooth gray cloth. *The Power Loom*

We have now made yarn out of cotton, and unbleached cotton cloth, or gray goods, out of our yarn. All that remains before the fabric goes to the finisher is an inspection for imperfections and their removal where possible, usually by hand.

Inspecting.

Sewing Ends Together.

CHAPTER X

Converting and Finishing

Old-Fashioned Bleaching

Cotton cloth as it comes from the loom has a gray or yellowish appearance due to the impurities it contains. The old-fashioned method of removing these consists in simply spreading the cloth in the sun for a few days until it is bleached white. Most cloth mills dispose of their goods in the gray and allow the finishing to be done by a separate establishment, although the large manufacturers of "fancies" sometimes do their own finishing.

Sewing Together

The first step in the finishing plant is to inspect the cloth and then to sew the ends of many pieces together into long strips. This greatly facilitates subsequent operations, because the cloth can now be run through various processes as a single unit.

Brushing

In order to obtain a smooth surface for later processes, the cloth is first run through a machine which brushes up the fibres and loose ends, much as a carpet-sweeper picks up the fibres of a carpet. Sometimes a bladed roller like a lawn-mower is used.

Singeing

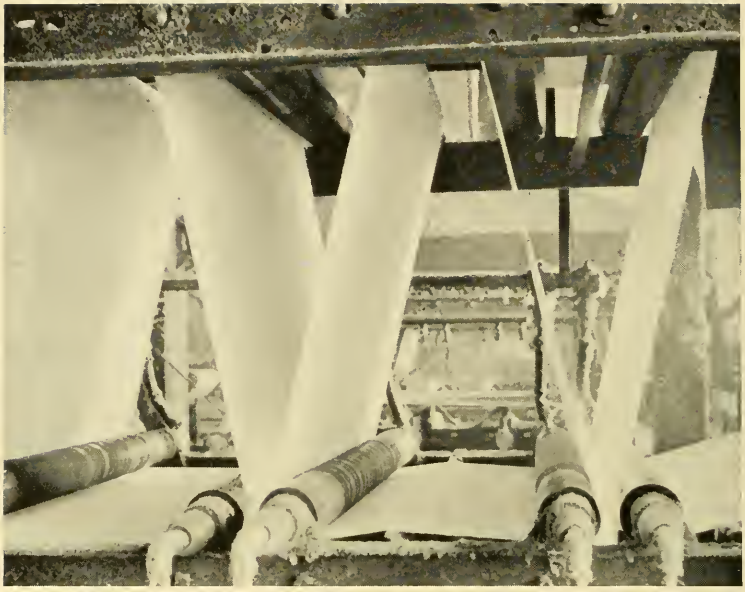
Removing the raised lint is a dangerous operation because it might easily damage the cloth, and this is usually done by the process of singeing. The cloth is run rapidly through gas flames or over hot plates and is quickly cooled. In this way the fuzz is burned off without injuring the cloth.

Napping

The next step is usually the bleaching process, except where the cloth is to be finished as a corduroy, velvet, or flannel. In the latter case it is first run through the napper, a machine which brushes up the fibre with wire teeth in such a way as to leave a raised face or nap.

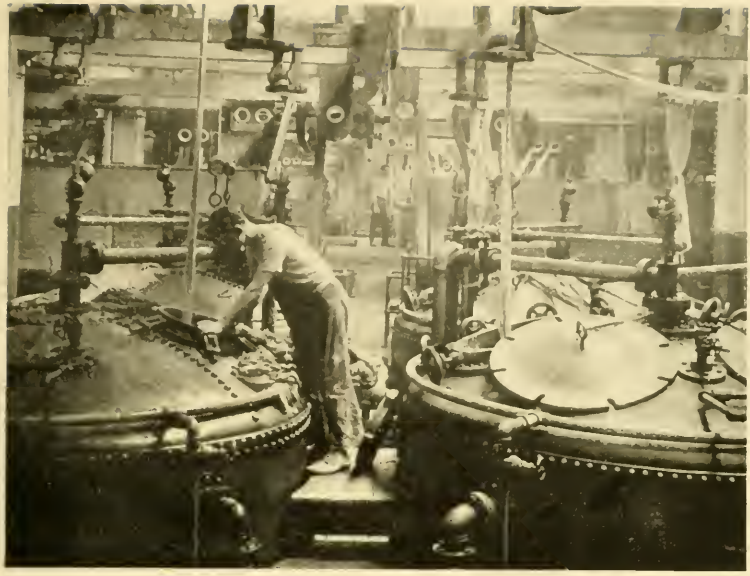
Bleaching Process

Bleaching is accomplished by boiling the cloth for several hours in large iron tanks known as kiers, which contain a solution of caustic soda. Next it is washed and scoured in dilute acid for several hours with the object of removing iron stains. Then it is again washed, boiled a second time, washed, run through a chemical solution of bleaching powder, and allowed to steep. After a last washing the cloth is dried by running over copper drums filled with steam, and is then rolled up in bundles about the size of a barrel.



Singeing

Napping.



Bleaching Kiers.

White Goods

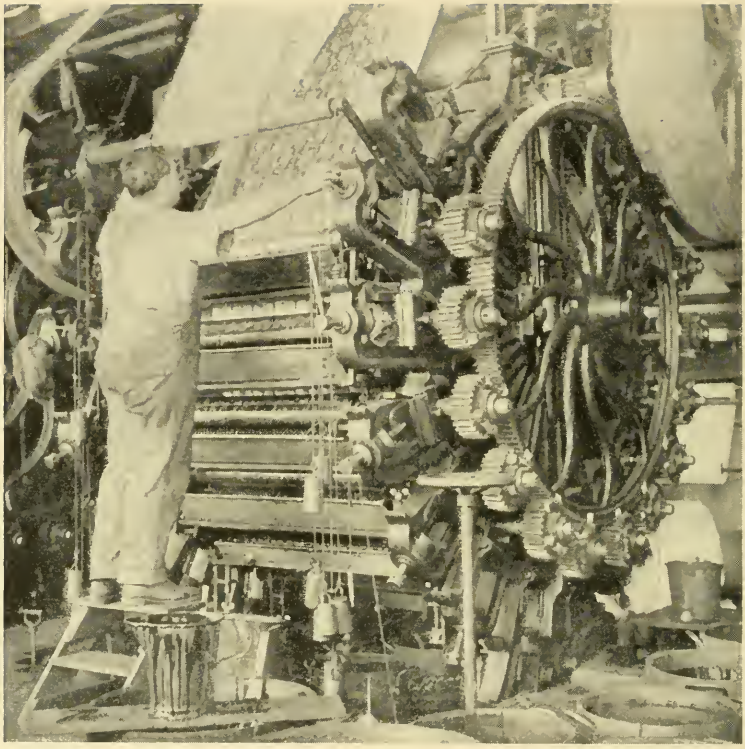
If the cloth is to be finished as plain white goods it is next starched and ironed (calendared), inspected, and put up in bolts for shipment.

If, however, it is desired either to dye or print the cloth with various colors and designs, it still has several treatments to pass through. White goods are sometimes mercerized, but more commonly this process is employed with cloth that is to be dyed. Mercerization is the treating of cotton yarn or cloth to the action of caustic soda dissolved in water, the remaining soda being removed by a wash of dilute sulphuric acid. The result is an increased strength of fibre, loss of elasticity, silky appearance, and an affinity for certain dyes and mordants.

Mercerization

The subject of dyeing is one of intense interest and wide scope, but it is unfortunately beyond the field of this brief survey. Suffice it to say that various chemical processes and mechanical devices are employed to give a permanent color to the cloth. (Yarn and raw stock dyeing are less commonly employed in the cotton than in the woolen and worsted industries.)

Dyeing



Printing Machine.

Resist and Discharge Printing

Some cotton cloth is simply dyed with a solid color and finished, but frequently it is first dyed with one color and then printed with others, or with a chemical which will discharge the dye and leave white figures wherever it touches the cloth. In contrast to this discharge method, where it is desired to obtain white figures on a colored back-ground, it is also possible first to print the figures with a chemical that will resist the subsequent action of the dye-stuff. Where a white ground is used and it is not essential that the colors and design appear on both sides of the cloth it is not necessary to dye at all.

A Battery of Forty-eight.

Printing Process

The printing process is a very old one, and was employed centuries ago in China and India, where natives used to impregnate cloth with colored designs by pounding small wooden blocks carved and filled with color on its surface. The modern printing machine has a series of copper rollers in which the design to be printed is etched or sunk. Under each roller where it is fixed in the printing press is a trough filled with the particular coloring matter which that roller is to print on the cloth. As the mechanism revolves the roller is constantly supplied with new color, which is scraped off its surface except where the sunken design holds it, by a knife, called the doctor. If the design calls for six colors there will be six rollers at work, and so on up to fourteen colors at a single run through the press.

Engraving Plate.

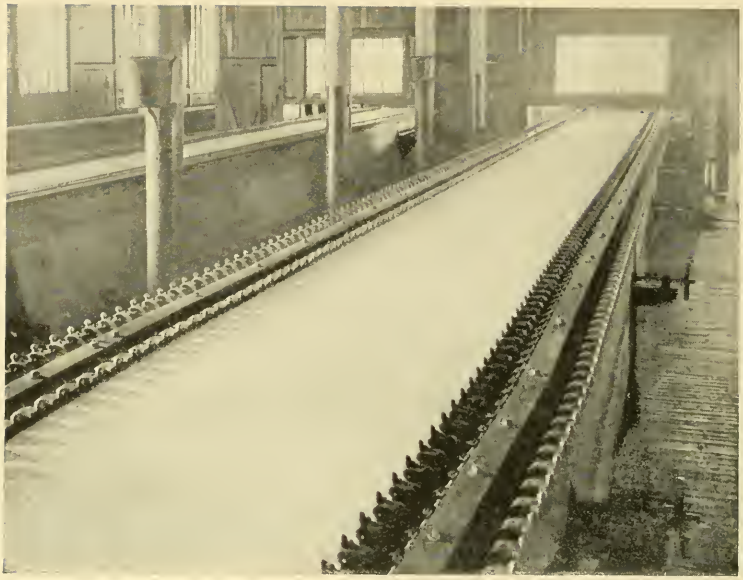
Engraving

An infinite number of designs are printed, and the method of getting them etched on the copper roller is a fascinating one. A zinc plate is carved by hand on a greatly enlarged scale from the original sketch, and from this plate the girls who operate the pantograph machines transfer the outlines of each color on to the copper rollers.

Transferring Design to Copper Roller.

The Pantograph

When the roller is placed in the pantograph it is coated with varnish. As the girl traces the outlines of the design on her zinc plate with a little pointer, she presses a treddle which brings a number of little diamond points in contact with the roller. Each one of these points cuts through the varnish, reproducing the design in its original size. There will be as many points as the number of times the design is repeated across the roller. When the roller is finished it is given a bath in nitric acid which will eat into the copper where the varnish has been cut away, thus sinking the design so that it will hold color.



Cloth in Tenter-frame.

Aging and Washing

There remain now only the finishing operations before the cloth is ready to be packed for the market. Usually, after printing, the cloth is steamed, or aged, to make the colors fast. Then it is fixed and soaped thoroughly, after which it is run through the drier.

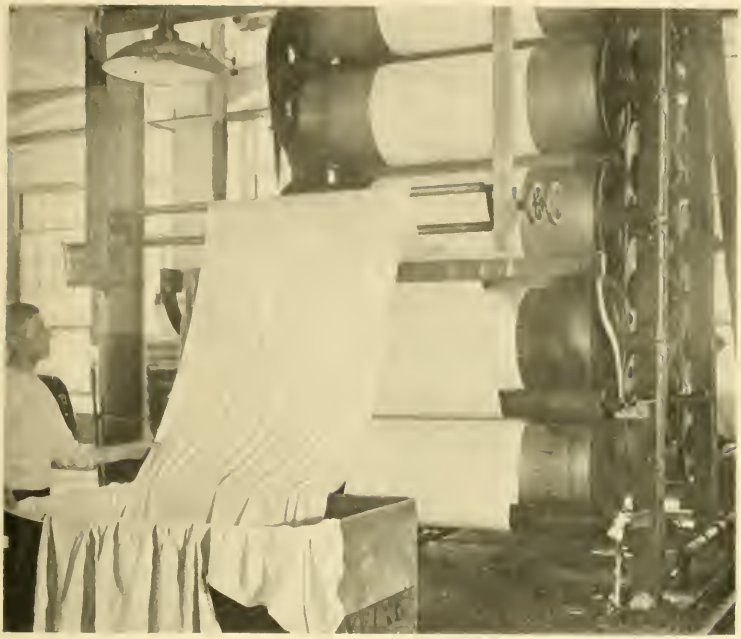
Starching

In order to give the cloth the proper "feel" an operation is next performed which closely resembles warp sizing. A certain amount of hot starch is pressed into the cloth, after which it is drawn through the tenter frames and not only dried but stretched back to its normal width.

The Tenter

The tenter frame is about one hundred feet long and contains long lines of steam pipes. On each side an endless chain with clips grips the cloth and moving gradually further apart, these chains stretch the cloth, delivering it dry and of even width. (Some goods, notably those made for Asiatic consumption in England, are not only starched but filled with China clay, which adds over 100% to their weight.)

As it comes off the tenter the cloth goes through steel rollers and is pressed smooth, after which it is automatically folded and made ready for ticketing and packing.



Calendar.

Folding.

CHAPTER XI

The Knitting Industry

History

We have just seen by what processes cotton yarn becomes first gray cloth, and then finished goods. There is of course a tremendous variety of woven fabric, ranging all the way from the coarsest sail cloth to the finest organdie. And there are certain finishes such as velveteen and corduroy which, for want of space, we have not even touched upon. There is, however, a whole class of cotton fabric which is not woven but knit; and since most of our hosiery and underwear are made in this way, it behooves us to take at least a brief glance at the knitting industry.

The principle of knitting is so familiar to every one who is or has a mother or wife that no description of it is necessary. Curiously enough, although the original stocking frame was invented as far back as 1589, power was applied to the industry for the first time at Cohoes, N. Y., in 1832. This city is still the centre of underwear manufacture in this country.

Two Types of Machines

Knitting is now done on two general types of machines: the flat bed knitter, and the circular knitting machine. In the former the garment is knit in one flat piece and seamed afterwards. Underwear made in this way is described as full-fashioned. On the circular machine a seam is not necessary, for the complete cylinder of fabric is made at once. While it is possible to manufacture underwear on a circular frame, its use is far better adapted to the knitting of hosiery, and a very large industry for the manufacture of this product has grown up in and near Philadelphia.

The Flat Bed Knitter

The Cotton Knitting Frame, invented in 1864, is still the basis of the modern flat-bed knitter. The product is a flat web which can be widened or narrowed by transferring the loops from the edge needles to a separate instrument, and then replacing them. In knitting stockings, the shaped legs are made on one machine, then transferred to a heeler, and then to a third machine which knits the feet. The stockings then must be seamed up the back. The largest machines are capable of knitting twenty-four garments at one time. The advantage of this type is that it produces more elastic fabric, but it requires more operatives and more highly skilled labor than the circular machine.

The Circular Machine

A series of inventions made in Philadelphia from 1867 to 1889 perfected the completely automatic circular machine of which there are now more than seven times as many in use in this country than there are full-fashioned knitters. The seamless machine goes on continuously and manufactures the entire garment at once. Narrowing is done by shortening the loops, and this accounts for the loss of elasticity.

The finishing operations consist of seaming where necessary and removing imperfections.

Growth

The growth and importance of the industry is perhaps best realized from the fact that in 1870 there were 5,625 machines in the country, in 1905, 88,374, and now well over one hundred thousand. In 1850 men wore hand-knitted socks and flannel underwear. From 1860 to 1910 the product of the country's knitting machines rose from $7,300,000 to $200,100,000.

Cotton yarn is used more than woolen because it spins cheaper and is less difficult to knit.

CHAPTER XII

Other Cotton Products

Before concluding this part of our survey which deals with the manufacture of cotton into finished goods, we must at least enumerate some of the by-products and minor fruits of the industry.

Seed Oil

To begin with, at the time that the cotton is ginned the seeds are sold to the manufacturers of cotton oil. Without going into detail as to the process, we have here an annual product for this country worth $384,000,000. Seed mills regin the seed before they crush it and remove the short fibres which have hitherto adhered to the seed. This regained cotton is known as linters and amounts annually to about 800,000 bales.

Linters

Felt and Surgical Dressings

Being of very short staple this reginned cotton is adapted for the manufacture of felts and surgical dressings, both of which are important by-products.

The manufacture of small-wares and lace curtains is another minor branch of cotton manufacture. Here, however, domestic production is comparatively small, and the bulk of the lace used is imported. Nevertheless probably over 75,000,000 yards* of the lace are made annually in this country.

Lace

Gun Cotton

Gun-cotton, a highly explosive substance, is obtained by soaking cotton (usually linters) in nitric and sulphuric acids and then leaving it to dry. And again, gun-cotton dissolved in ether and alcohol yields the much used surgical adhesive known as collodion.

Collodion

The stems and leaves of the cotton plant are used for fodder, the seed hulls for fertilizer, and there is in fact no part of the plant from which man has not learned to derive some useful product.

*This figure is only roughly approximated.

PART THREE
FROM MILL TO CONSUMER

CHAPTER XIII

Industrial Organization

Before we proceed in the next chapter to discuss the various ways in which cotton goods are marketed we shall first take a cursory glance at the way in which the industry is subdivided.

The Mill Treasurer

The president of a cotton mill is usually not the active head of the business; his position corresponds to that of the chairman of the board of directors in the usual banking or mercantile corporation. The mill treasurer is, on the other hand, the chief directive force, and he performs the two all-important functions of buying the mill's raw cotton and selling its product, either direct or through other channels. In the mills of New Bedford and Fall River, which make chiefly gray goods, the treasurer usually has his office at the mill. In most other New England mills the treasurer is usually a member of a selling house and is frequently the treasurer for more than one mill.

The Agent or Supt.

Where the treasurer has his office in the mill the man who has charge of the actual operation is known as the mill superintendent. His functions include the general management of the plant and the purchasing of supplies other than cotton. Where the treasurer maintains his office in a selling house, the operating head is known as an Agent and enjoys a greater degree of responsibility and independence. There are of course a varying number of minor operating chiefs in charge of sundry departments.

Spinning and Weaving in Same Plant

The average New England cotton mill contains about fifty thousand spindles, while the Southern mill runs about twenty-five thousand. The vast majority of mills do both spinning and weaving, although some Southern mills sell yarn and some Pennsylvania establishments do nothing but weave. Of the entire number of spindles in the country, 83%, and of the looms 97%, are in mills which do both spinning and weaving.

Segregation of the Converter

In contrast to the tendency towards unification in spinning and weaving is the ever-increasing segregation of the converting plants. The rise of the merchant-converter, whom we shall encounter in the next chapter, the growing demand for a great variety of finishes, and the fact that converting is very much cheaper on a large scale, have all brought about an increasing tendency on the part of the mill to sell its cloth in the gray, or to have it finished on commission.

Knitting

While a few large knitting mills spin their own yarn, this is the exception rather than the rule. On the other hand the knitting mills finish their product for the market themselves, and sell either direct or through a selling house.

CHAPTER XIV

The Distribution of Products

There are four general ways in which a cotton mill may dispose of its products: 1. By selling direct. 2. Through a selling house. 3. Through a broker. 4. Through a converter.

1. *Selling Direct*

A few very large mills maintain selling offices of their own in the large centers of distribution through which they market their goods direct to the jobbers and retailers. In most cases where direct selling is done, however, the goods are sold in the gray by the mill treasurer at the mill. This practice is common with those mills which make staple gray goods and which, when not sold ahead, are able to manufacture for stock against spot sales. A few Southern yarn mills also sell direct.

2. *Growth of the Selling House*

The relation between the manufacturer and commercial banker or commission house is as old as the industry itself. Slater's first mill in 1790 was financed by Almy & Brown of Boston, who undertook to market his goods and also to furnish him the credit he needed to buy cotton and supplies. In the early days the cloth was sold at auction by the selling house and the proceeds less commission credited to the mill. Later on the factors developed extensive selling organizations throughout the country by means of which they were able to market the products of a good many mills.

"Fancies"

The distribution of fancy goods requires a great deal of skill. The Fall and Spring lines to be manufactured by the mills are sent out to the trade by the selling house about six months ahead, and orders are taken before manufacture begins so as to be sure that the line will "take". Of course there is always the danger of cancellations even then, for which the selling house must bear most of the responsibility.

Finances

In addition to distributing the goods and guaranteeing the accounts, the commission house renders financial assistance either by advancing on the mill's product, or by indorsing its notes. In return it receives the sole agency for the mill's products, interest on the money advanced, and a commission. The latter varies with the amount of financial assistance required by the mill and the desirability of the risk.

As a general rule the Southern mills, because of their distance from the chief markets in New York, Boston, and Philadelphia, are more dependent upon their selling agents than the New England manufacturers.

In New England a great number of manufacturers are amply able to finance themselves, and could if necessary sell their own products. Stock ownership, however, and old ties have frequently kept up the relationship with the selling houses after its usefulness was partly outworn. Nevertheless in the selling of fancy goods, even where the mill

is supplied with plenty of capital, the commission house fulfills a very necessary function.

3. *The Broker*

Gray goods are very often sold either by a mill or a selling house through the medium of a cloth broker. The latter is strictly a middle man in that he does nothing but bring together prospective purchaser and seller. In the event of sale he gets a commission of ½%, which he often more than earns by his efforts. These brokers are in touch with all the mills, converters, and consumers.

4. *Merchant Converters*

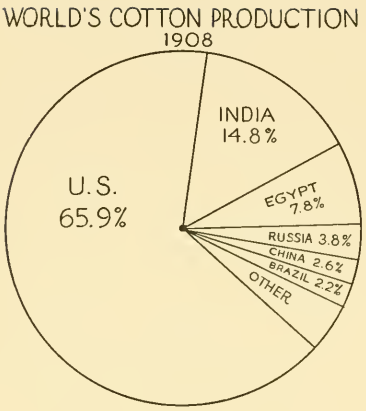
While there are some independent finishing establishments, most of them operate on a commission basis for merchant converters. The latter are a class of merchants of comparatively recent origin, having appeared first about 1880, since which time they have practically taken control of the finishing industry. They buy gray goods either direct from the mill, or through a broker or selling house, and have them finished according to whatever they think the requirements of the market are. Inasmuch as they pay on short credit and carry the goods during conversion, frequently selling on several months' credit to jobbers and retailers, they perform an important part of the financing of the cloth. Their recent rapid rise has been due largely to the growing demand for a multiplicity of seasonal designs.

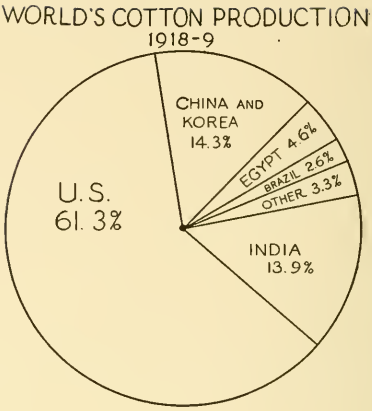
Some large cutters-up, and a few big mail-order houses do their own finishing or have it done. As a rule they buy from converters and sell to the jobber, retailer, or consumer.

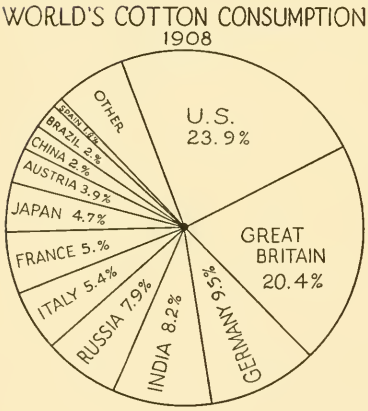
We have now traced the cotton from the seed through the various processes of manufacture and finishing, and followed the finished goods through the channels of distribution to the consumer. It remains only for us to compare briefly the position of the United States with that of other countres, and the position of the various sections within the United States.

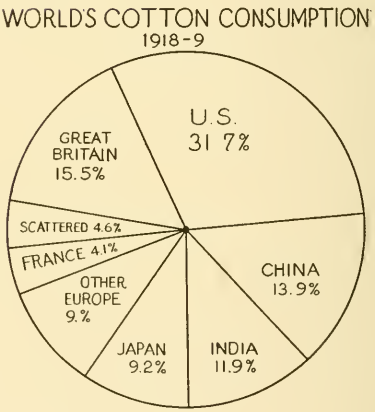
PART FOUR

THE POSITION OF THE UNITED STATES


WORLD'S COTTON PRODUCTION
1908
U.S.
65.9%
INDIA
14.8%
EGYPT
7.8%
RUSSIA 3.8%
CHINA 2.6%
BRAZIL 2.2%
OTHER


WORLD'S COTTON PRODUCTION
1918-9
U.S.
61.3%
CHINA AND
KOREA
14.3%
EGYPT 4.6%
BRAZIL 2.6%
OTHER 3.3%
INDIA
13.9%


WORLD'S COTTON CONSUMPTION
1908
U.S.
23.9%
GREAT
BRITAIN
20.4%
GERMANY 9.5%
INDIA 8.2%
RUSSIA 7.9%
ITALY 5.4%
FRANCE 5.%
JAPAN 4.7%
AUSTRIA 3.9%
CHINA 2.%
BRAZIL 2.%
EGYPT 1.%
OTHER


WORLD'S COTTON CONSUMPTION
1918-9
U.S.
31.7%
GREAT
BRITAIN
15.5%
SCATTERED 4.6%
FRANCE 4.1%
OTHER
EUROPE
9.%
JAPAN
9.2%
INDIA
11.9%
CHINA
13.9%

CHAPTER XV

Cotton Production and Consumption

Ever since the Civil War the United States has produced more than half of the world's cotton crop. From 1860 to 1900 about one-third of the annual crop was consumed by the domestic industries, and from that time domestic takings have increased to an average of over 50% in the last four years. During the same period the actual size of the annual crops increased enormously. If we take the figures from the present back to 1868-9 in decennial periods it will give a rough idea of the progress since that time.

Season	Crop in bales		Exports	% of dom. takings
1868-9	2,434		1,447	41%
1878-9	5,074		3,466	31
1888-9	6,939	thousands	4,736	33
1898-9	11,256		7,313	32
1908-9	13,817		8,447	38
1918-9	11,360		5,646	48

The banner years were from 1911-2 through 1914-5, the largest individual year being 1911-2 with 16,101,000 bales. The last four years have shown a marked falling off, due chiefly to the shortage of labor and fertilizer brought about by the War.

While the last year was in many respects an abnormal one it will be interesting to note the position of the United States as a producer and consumer of cotton with respect to the rest of the world. The circular diagrams will perhaps present the picture more graphically than words or figures, and in order to afford a basis of comparison, the International Bureau of American Republics' figures for 1908 are reproduced.

CHAPTER XVI

Export of Cotton Goods

World's Spindles

While the United States holds undisputed supremacy in the production of cotton this is not true in the field of cotton manufacture. Of the total cotton spindles in the world, estimated in 1919 at 153,505,000, Great Britain had 59,000,000, the United States 34,200,000, and Germany was ranked third with 10,000,000.

Piece Goods Production

In spite of this preponderance of spindles in the United Kingdom Professor M. T. Copeland's averages for the period of 1910 to 1913 show two surprising facts: first, that out of a total of 7,816,500,000 pounds of cotton piece goods produced in the world the United States produced 24.4% against 18% for Great Britain; and second, that Great Britain's 59 million spindles consume only about one half as

much cotton as the 34 million in this country. The reason for this is that the British manufacture a far greater proportion of fine goods than we do.

World's Exports

Professor Copeland estimates that of the seven billion odd pounds of cotton piece goods produced in the world only about 22.5% were exported from the countries where they were produced. Out of this 1,754,700,000 pounds exported, Great Britain exported 64% and the United States only 5.7%. In other words, where we consume about 95% of our production, Great Britain consumes only about 22%, and so must seek foreign markets for 78% of her goods.

U. S. Exports

Our own export trade in cotton goods has grown up as an accident rather than from any carefully planned campaign. Since the American manufacturer has always had a market at home for practically all he produced he has made very little effort to enter foreign fields. Moreover, where British merchants have hitherto enjoyed the advantage of the most complete network of transportation and banking facilities in all parts of the world, our merchants have had to ship their goods in foreign bottoms and finance them through foreign banks. It is only recently that a few of the country's largest and most progressive banks have established branches in foreign countries, notably in South America, through which the would-be exporter can procure assistance, and the phenomenal growth of such establishments bears witness to the existing need.

Branch Banking

American Mills do not cater to foreign taste

One corollary evil to the large home market has been that in the past our manufacturers have not made any appreciable effort to accommodate the demand in foreign countries. Poorly equipped salesmen were sent out to South America to sell the natives not what they considered stylish goods, but "the latest thing on Broadway." The result has been that we have only been able to pick up the crumbs left by British and German merchants.

The War

The War brought about a condition where Germany was totally put out of the running and Great Britain could only supply a part of the goods she was accustomed to sell her foreign customers. This constituted a splendid opening for American trade, but the fact that our factories were running overtime to meet the war-needs of our Allies, together with the scarcity of labor and raw material, prevented our taking advantage of this opportunity to the fullest extent. Nevertheless satisfactory progress has been made of recent years, and our exports in 1919 amounted to over 273 millions of dollars.

The Future

South and Central America, Cuba and the Philippines, Australia and China are the chief markets for the American exporter of cotton goods, and it is to be hoped that trade with these countries will continue to show a yearly gain. Moreover, when the exchanges of European countries are again restored more nearly to their par values, we may hope to see our cotton goods sold on European markets in large quantities.

CHAPTER XVII

Import of Cotton Goods

Past and Present Imports

In the early days of the cotton industry in this country we imported practically everything except the coarsest cloths. The War of 1812 cut off British goods and started American manufacturers making various fabrics they had hitherto not attempted, so that by 1860 our imports of cotton goods had been limited to practically the finest grades of cloth. Since that time the protective tariff and labor-saving inventions have made it possible for us to reduce our imports of cotton piece goods down to about ½% of our consumption. The only cotton product which we import rather heavily at the present time is lace.

1920

The most recent Department of Commerce figures show a phenomenal increase in cotton goods imported in the first half of 1920. The salient items are tabulated below. It would be mistaken to argue from these figures that our imports are on the increase. The decline of foreign exchanges, but more than that, the abnormal demand for goods and the sold out condition of our manufacturers in the first months of the year, caused large importations of cloth for the sake of the earlier deliveries promised by foreign manufacturers. Since then the drastic decline in prices and numerous cancellations have restored conditions far more nearly to normal, so that it would be surprising if the figures for the second half-year did not show very much smaller imports.

	1910	1918	1919	1920 First 7 mos.
Cloth Yards	61,947,101	45,015,423	24,474,101	104,563,210
Cloth dollars	$9,040,667	$13,266,394	$9,324,412	$36,586,798
Lace Yards			309,195,754	165,666,868
Lace dollars	$36,828,162	$10,421,083	$7,721,040	$9,520,116
Total Cotton Products Dollars	$68,052,731	$44,751,181	$34,762,723	$90,291,273

American Jobbers and Retailers

Foreign manufacturers and merchants sell some of their goods in this country, but the bulk of the importation is carried on by American jobbers and retailers, particularly by the large department stores, which send their buyers to Europe. Through buying direct from foreign manufacturers these concerns save much of the cost of importation.

Possibilities of Trade with Germany

The present situation in Germany presents some interesting possibilities for the American cotton trade. Before the War Germany and Japan constituted the chief outlets for the short staple cotton grown in this country, and due very largely to the withdrawal of Germany from world commerce, considerable stocks of short cotton have accumulated. The necessity for either carrying the short staples or else selling them at a sacrifice has worked quite a hardship on the American cotton trade. Germany, on the other hand, is able to run only a small proportion of her ten million spindles, chiefly because of the lack of raw material.

It would seem, therefore, that a possibility exists of building up a trade with her whereby she would obtain cotton here, manufacture it into goods, and pay us either in finished goods or with the proceeds of selling them in continental markets. The chief difficulties are presented by the demoralized condition of German exchange and German credit, but these obstacles should not be insuperable; in fact steps have already been taken in this direction by some American interests.

CHAPTER XVIII

The Various Sections of the United States

In a previous chapter we have outlined the early growth of the cotton manufacturing industry in the United States. We saw that in 1860 there were 1091 mills of which 570 were in New England, 340 in the Middle Atlantic States, 159 in the South, and 22 in the Middle West. We noted also that 48% of all the spindles were in the states of Massachusetts and Rhode Island.

Middle Atlantic States

The Middle Atlantic States have made very little progress in this industry since the Civil War. The number of establishments has decreased, and the spindlage has remained fairly near the million and a half mark since 1900. At the same time this statement is somewhat misleading, because Philadelphia, while not a spinning centre, is the nucleus of an extensive fancy weaving industry, the chief product of which is cotton upholstery. Moreover, 60% of the knitting industry is located in these states, underwear manufacture being focussed at Cohoes, N. Y., while hosiery knitting mills are grouped around Philadelphia. New York and Philadelphia are furthermore important as cloth markets and as the home of a great number of merchant converters.

The South

We have already noted the phenomenal rise of the South as a manufacturing section since the Civil War and particularly since 1880. In 1919 14,600,000 of the 34,200,000 spindles in the country were estimated to be in the Southern states. South Carolina has the largest mills and spins the finest yarns, but the industry has also grown to very large proportions in North Carolina, Georgia, and Alabama. The Southern mills predominate in the production of the coarser yarns and cloths, such as sheetings, shirtings, cottonades, duck, and drill. They also make a considerable quantity of ginghams, ticks, denims, and stripes.

Advantages and Disadvantages

Proximity to the source of raw material saves freight and tare, but this is more than off-set by the loss of freight on cloth and the remoteness from the markets. Tax rates are lower in the South, but against this there is not the industrial concentration characteristic of New England. The chief advantage of the Southern mills heretofore has been in the abundance of cheaper labor and longer hours, but it is a

question whether the growth of the industry has not already discounted this factor. One unfortunate feature is that the Southern mills cannot do their own finishing because in most cases the water is unsuitable.

New England

The tendency in New England since the Civil War has been towards fewer and larger mills. As against 570 mills with 3,859,000 spindles in 1860, there were 308 with 13,911,000 in 1905. The early mills located where there was water-power or tide-water coal, and this has brought about a concentration of the industry in a few large textile cities. New Bedford, Fall River, Lowell, Lawrence, and Taunton in Massachusetts, Manchester, N. H., and Pawtucket, R. I., contain over one third of all the spindles in the country. The looms of Massachusetts alone turn out two billion yards of cotton goods per year,—1,136,363 miles at the rates of eight miles per minute! This would be eighteen yards for every person in the United States, and we are estimated to consume nineteen yards per person. Massachusetts is third in knitting, and, according to W. J. Showalter, makes enough hosiery each year to cover 40,000 miles of feet or legs.

Reasons for Supremacy

New England predominates in the manufacture of print cloths, twills, fancy weaves, sateens, plush, velvet, and corduroy, besides making about half of the ginghams, ticks, and denims, and a great variety of other minor lines. Four Capital Cs make for a continued supremacy of this section of the country in textile manufacture: Capital, Concentration, Credit, and Climate. The last constitutes a very important factor, for not only is the humidity in New England peculiarly adapted for cotton manufacture, but the water, which in the South is too alkaline, lends itself admirably to the finishing processes. Labor in New England is more expensive, but also more efficient, even though the recent reduction from the 54 to the 48 hour week has apparently set the country back as much as if over three and one half million spindles had been wiped out. Whether this loss is permanent, or will ultimately be offset by increased efficiency, remains to be seen.

Textile Machinery

A survey of the cotton industry, no matter how brief, would not be complete without a word about the manufacture of textile machinery. Practically all the machinery used in this country is of domestic make. As might be expected, gins and compresses are made very largely in the South, but practically all the yarn making machinery is produced by about seven concerns, all of which are in New England. Furthermore all the looms made in this country are constructed by four large manufacturers, all of whom are located in Massachusetts. Finishing machinery is made to a large extent in the fancy weaving center of Philadelphia, but a heavy percentage is also manufactured in New England. Finally, most of the knitting frames are built by New England manufacturers. It is not without reason that this section of the country has been called "The Beehive of Business."

THE FIRST NATIONAL BANK OF BOSTON
AND THE
COTTON INDUSTRIES

SPINDLES

In the Country	34,200,000	
In New England	18,065,857	53%
In mills which are customers of The First National Bank of Boston	5,501,362	16%

30% of the spindles in New England are in mills which are customers of The First National Bank of Boston.

LOOMS

In the Country	672,754	
In New England	377,121	56%
In mills which are customers of The First National Bank of Boston	122,908	18%

32% of the looms in New England are in mills which are customers of The First National Bank of Boston.

About 90% of the textile machinery used in all the cotton mills in the United States is manufactured by concerns which are customers of The First National Bank of Boston.

Besides this a great number of the leading cotton merchants, brokers, converters, and knitters, as well as seed oil producers, are customers of The First National Bank of Boston, not to mention the large selling houses through which it indirectly shares in the financing of a great number of mills whose spindles and looms have not been taken into consideration above.

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